# THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction


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**Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.**


Deep in the dry desolation of the Mojave Desert, industrial explosives, seepage, and sun are combining forces to produce a lot of salt and calcium chloride for California Salt Company of Los Angeles.

The company's operations are actually a dual mining project. After overburden is stripped from a pit section one-half mile long and 70 ft. wide, the underlying layer of rock salt is blasted with extra dynamite 30% and hauled to the processing plant. Draglines cut into the clay bed in the pit bottom and natural seepage starts. Brine, impregnated with calcium chloride, oozes out and stands in the pit. Then, the sun draws off the water, the salt drops to the bottom, and the residue is calcium chloride.

An interesting account of this unusual mine and its operations near Amboy, California, is presented by Lewis Nordyke, beginning on page 134.

* * *

At Buggs Island Quarry near Clarksville, Virginia, the working face is a massive granite that averages 120 ft. in height and 800 ft. in length. The formation is practically devoid of bedding planes and fissures. Its extreme abrasiveness makes drilling difficult.

Soon after Marks-Wicker Company took over the operation of this quarry, experiments in drilling and blasting were conducted. These resulted in the adoption of the well-drill method, using 6-in.-diameter holes spaced on an average of 18-ft. centers. The success of this method brought about lowered costs and a more uniform quarry floor.

In the article on page 143, John Dantzler describes operating procedures centering around a recent blast of 62,800 lb. of Hercules® Gelatin Extra Dynamite that produced 144,000 tons of well-broken granite.

* * *

Tuttle Creek Dam, now under construction across the Big Blue River, 6 miles north of Manhattan, Kansas, is a vital link in the Army Engineer's Pick-Sloan plan for flood and drought control in a 12-state area. It is scheduled for completion in 1961 at an estimated cost of $90 million.

The dam embankment, 7,500 ft. long, will contain 20,000,000 cu. yd. of rock and earth. The 50-ft.-wide crest will be 157 ft. above the river bed, and the base 1,640 ft. wide at its widest point. The total flood capacity of the dam is 2,280,000 acre-feet.

A review of the construction details involving the drilling, blasting, and excavating of approximately 4,500,000 cu. yd. of limestone and shale formations will be found in the article by L. H. Houck on page 147.

* * *

The demolition of a 34-year-old coal tipple with industrial explosives on August 2, 1957, ended the era of the steam locomotive at the Chicago and Northwestern Railroad yards in Madison, Wisconsin.

The project was completed in a little over three days at a total cost of $410.

How this precision-blasting job was accomplished without damage to surrounding railroad tracks and structures is described by J. S. Ong in the article on page 154.

* * *

Errata: In our July-August, 1957, issue, the last name in the caption under the illustration at the upper left of page 106 reads Edward Taigger. This should have read Edward Twiggar.

In the same issue, the caption under the illustration on page 118 read, in part, "Bucyrus-Erie power shovel." This should have read "Marion power shovel."

We regret that these errors were not detected before the issue was printed.


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VOL. 35 NO. 5 SEPTEMBER-OCTOBER, 1957

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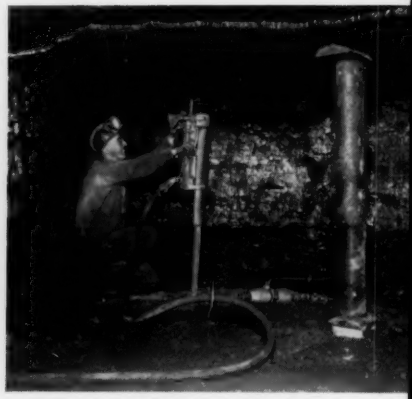

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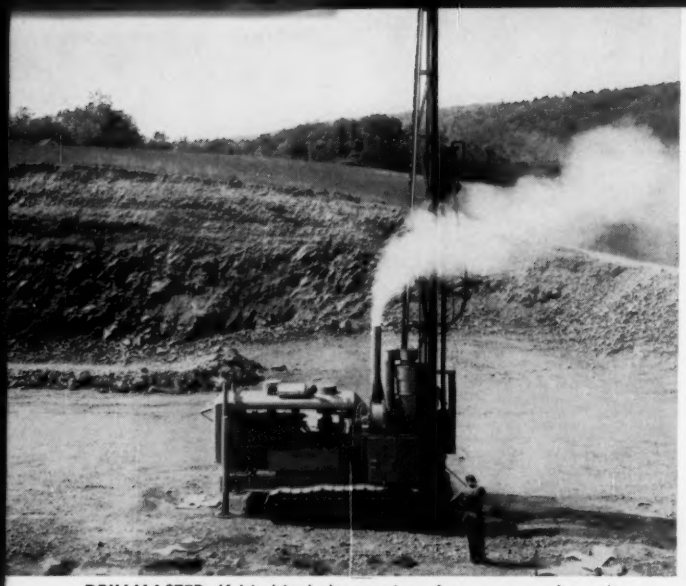

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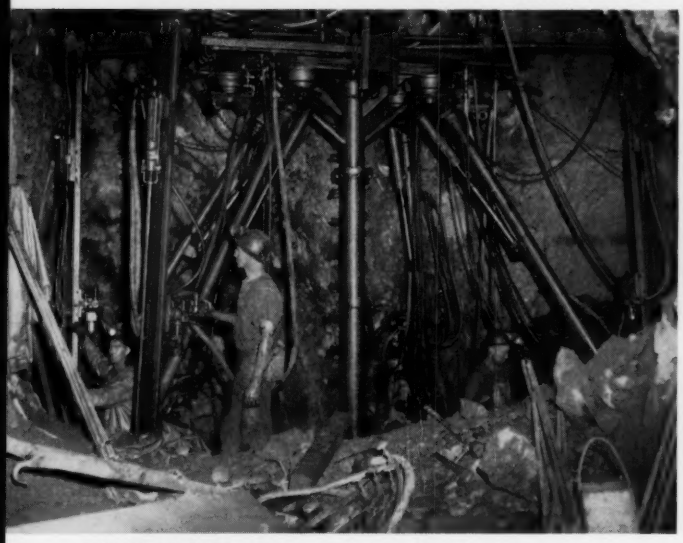

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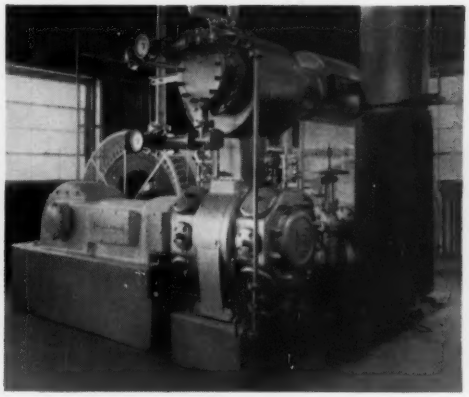

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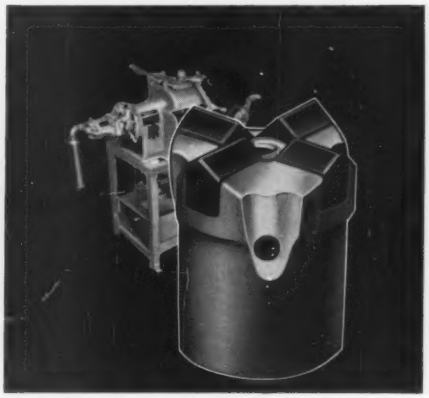

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NORMAN ERNEST KELB

# Norman Ernest Kelb

PRESIDENT, NATIONAL CRUSHED STONE ASSOCIATION;
CUMBERLAND QUARRIES, INC.;
AYRSHIRE COLLIERIES CORPORATION

## A Biography

WHEN Norman Ernest Kelb was elected president of the National Crushed Stone Association for the second time in February, 1957, his associates paid a tribute to a gracious and modest gentleman who has made a success of both his business and personal life.

Norman was born April 2, 1893, in Toledo, Lucas County, Ohio, the son of Frank F. and Theresa (Himmelmann) Kelb. Both of his parents were of German ancestry.

After completing his formal education in Toledo's grade and high schools, Norman worked at several jobs, including the selling of real estate. In the latter part of 1913, he began his long association with the crushed stone industry when he went to work for France Stone Company in its Toledo office. Three years later, he was transferred to France Slag Company in Detroit. This move afforded him opportunities to engage in both sales and plant operations.

In 1919, following his discharge from service with the U. S. Army during World War I, Norman moved to Greencastle, Indiana, where the France interests operated the Ohio and Indiana Stone Company. While there he was honored, in 1925, by being elected to the presidency of the Indiana Crushed Stone Association. Two years later he moved to Indianapolis.

When Erie Stone Company established its headquarters in Indianapolis in 1929, Norman was made secretary-treasurer and general manager of this organization and of the Ohio and Indiana Stone Company.

In 1941, Cumberland Quarries, Inc., was organized to produce the aggregate to be used in the construction of Wolf Creek Dam in Kentucky, with Mr. Kelb as its president. Work on the dam was suspended in 1942 because of World War II. At the conclusion of the war, the construction of the dam was resumed and the Cumberland Quarries supplied the stone requirements on the project. Soon after the completion of work at Wolf Creek Dam, part of Cumberland's equipment was sold and part was relocated at St. Paul, Indiana, where the company, through its subsidiary, St. Paul Quarries Company, is producing and distributing crushed stone products today.

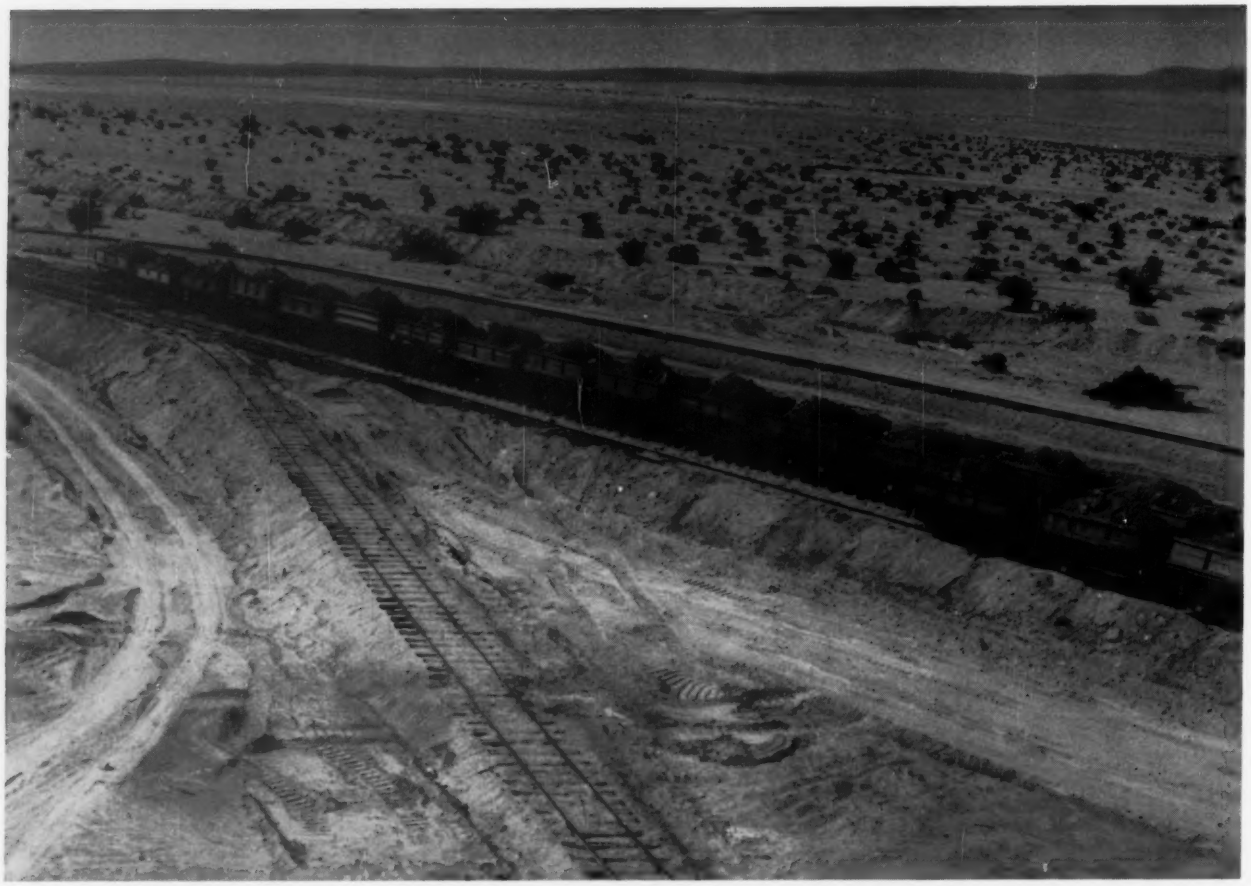
On several occasions the members of the National Crushed Stone Association have honored Norman Kelb: he was made a member of its Board of Directors in 1935; he became a regional vice president in 1936; and two years later a member of its executive committee, serving in both capacities through 1940. Six years later he was returned to membership on the Board of Directors and has remained to date. He was elected to the presidency of the association in 1956, and was re-elected in 1957.

Besides being president of Cumberland Quarries, Inc., Norman is also president and a director of Ayrshire Collieries Corporation, a large producer of coal from its shaft and strip-mine properties in Indiana, Illinois, and Kentucky, and a vice president and a director of Railway Service and Supply Corporation. He is a director of Republic Coal and Coke Company, a director of National Coal Association, a member of the Chamber of Commerce of Indianapolis, and a member of the Shrine.

His club memberships include the Columbia and the Ulen Country.

Norman Ernest Kelb married Carrie Bernice Schill on August 15, 1917, in Toledo. They have one son, Edwin D. Kelb. Mrs. Kelb died in 1948 and, four years later, Norman married Zelma Bird in Indianapolis. The family home is at 3941 Ashbourne Lane in Indianapolis.

Norman's principal hobbies are the development and promotion of his varied business interests, and participation in community affairs. His recognized abilities, plus warm appreciation and understanding of his fellowmen, have won for him the admiration and loyalty of his many friends and associates.



SALT FROM THE DESERT: This picture of a string of Western cars loaded with rock salt from the mine near Amboy, California, includes a section of the big and barren terrain of the Mojave Desert in the background.

# California Salt's Mine In the Mojave

## Open-pit operations in Bristol Dry Lake, near Amboy, combine the forces of dynamite and the hot rays of the sun to produce rock salt and calcium chloride

LEWIS NORDYKE*

DEEP in the dry desolation of the Mojave Desert, seepage, sun, and industrial exposives are combining forces to produce a lot of salt and calcium chloride for California Salt Company of Los Angeles. After the shallow overburden has been stripped and a layer of salt is blasted and removed, the pit is trenched. Then a natural seepage of brine, strongly impregnated with calcium chloride, sets in. Later, the brine is placed in earthen vats under the wide sky and the sun starts its work. Solar evaporation removes much of the water while, at the same time, the salt drops out, and the end product is ready for delivery to meet the market demand.

The mine, which has been in oper-

*2809 Lipscomb Street
Amarillo, Texas

ation for many years, is located near Amboy, California, in the middle southeast portion of San Bernardino County, about 225 miles to the east of Los Angeles and 84 miles west of Needles. It is on the Sante Fe Railroad, which has a spur running to Saltus, a rail loading point where the salt-washing plant is located. Amboy, a wide place in the road, is the supply and trading center of the desert area. More specifically, the California Salt Company's operation is in Bristol Dry Lake, which has an interesting but puzzling geology.

The terrain is big and barren and has a sterile look; anyone can find a lot of sun and solitude out there. The altitude is 510 ft. The temperature in the scant shade sometimes sizzles up to 121 degrees Fahrenheit and up to 180 degrees in the sun. The summer heat is dry. Water for drinking purposes is hauled 45 miles by rail from Newberry.

But this desert country has yielded to the industry of enterprising men and has produced useful products for half a century. Common salt is the most plentiful. The region has also produced gypsum and celestite, a strontium sulphate that is little in demand. At present, the main products of the area are calcium chloride and salt, with California Salt Company the major operator.

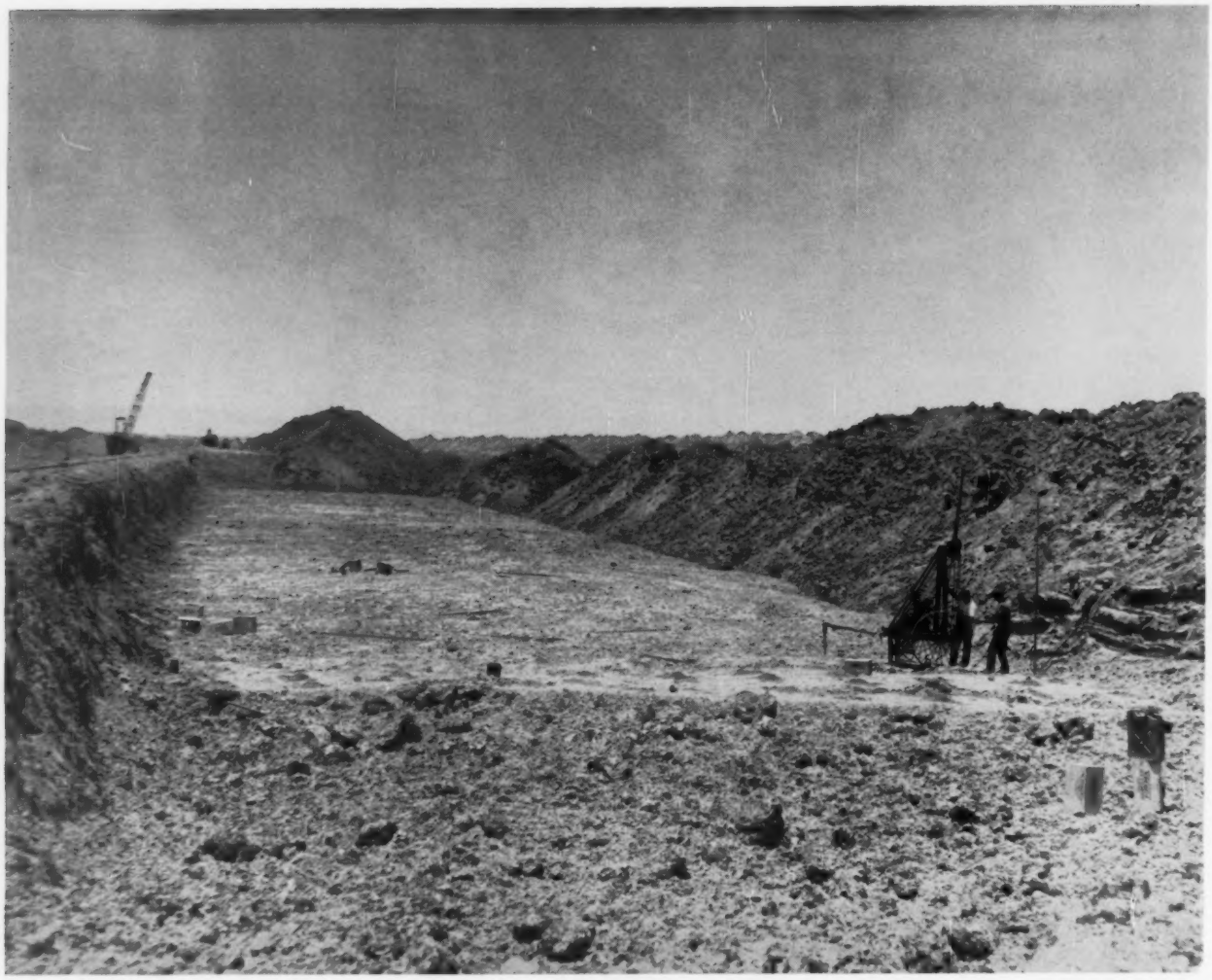
### Picturesque Country

The country is picturesque for many miles around. Standing in the area of the pits that produce salt and calcium chloride, you shade your eyes, look around, and the world seems to slope down toward you from all sides. In the distance the blue hulks of mountains loom on the horizon. There are the Old Woman, the Ship, the Marble, the Turtle, the Bullion, and the Bristol Mountains; and a hull of a hill, the Bagdad Crater, once a lively volcano. Its black basaltic lava still lies on the surface.

The things that have happened here through the ages are somewhat puzzling to geologists. No one quite understands how the layers of various formations that fill what was once a yawning chasm were laid down so uniformly. A drill hole of several hundred feet revealed alternate layers of clay and salt, each averaging 6 yd. thick all the way down. In the pits of California Salt Company, the first layer of salt is invariably the same thickness as the overburden that caps it. No one knows how deep the salt goes, or just how it got there.

However, there is general agree-

**STRIPPING OVERBURDEN:** The salt formation near Amboy is covered with a clay and sand overburden of varying thickness, averaging 7 ft. This is removed with draglines that dump the waste out of the way of pit operations.



**DRILLING BLAST HOLES: After the salt is uncovered the average pit is 65 to 70 ft. wide and from one-quarter to one-half mile long. Holes for blasting the salt are drilled about 7 ft. deep with company-designed drills on iron wheels.**

ment that in ages past quite a trough or depression existed here. It has been filled to an undetermined depth by the sedimentary deposits that have washed down or were carried by the channels of streams that are no longer there.

One theory is that the depression containing Bristol Dry Lake, also neighboring Cadiz and Bagdad Dry Lakes, could have resulted from the tilting of a valley of the Pleistocene Age. It is considered possible that the valley might have been part of a one-time channel or overflow from the Mojave River.

Actually, the filling process is still going on. When an infrequent rainstorm hits, the waters roll down the slope into the lower parts of the basin, carrying whatever salts, sand, gravel, and clay they pick up from the rocks over which they sweep. In the low places, the water gathers in thin sheets and becomes motionless, and the suspended sediment settles out, adding to the fill. Bristol Dry Lake has no exterior drainage.

### Underground Lake

Strangely enough for this desert stretch, there remains a lake underground; its water level rises and falls like that of a surface lake. As we shall see, this underground water, brackish as it is, aids California Salt Company in its operation.

The mysteries of the desert formations are many, but American mining engineers and industrialists are not particularly concerned about the happenings and geology of untold ages. They have learned how to do whatever it takes to recover useful material economically and profitably.

When you're out on the desert in summertime and feel the biting burn of the sun, you don't wonder at its evaporative capabilities. But, the idea of water seepage out there seems almost unbelievable. But there it is in old Bristol Dry Lake.

Before natural processes can take hold, man has to do some digging and dynamiting to get things started. The average pit is 65 to 70 ft. across and from one-quarter to one-half mile in length. The overburden, largely clay with a sandy top, varies somewhat in thickness – averaging about 7 ft. Strip-

ping this overburden is done with draglines that dump the waste out of the way of pit operations. There are three 95 Northwest draglines, each with a 70-ft. boom and a 2½-cu. yd. Page automatic bucket. Each is powered by a Murphy diesel engine. There is also one Lorain dragline with a 1½-cu. yd. bucket, powered by a Caterpillar D-13000 engine.

The draglines excavate the surface material down to the salt, which lies fairly level. The salt is the rock sort, very hard in some places and soft in others. It varies in thickness, averaging 7 ft.; in some places, however, it is only 3 ft. thick.

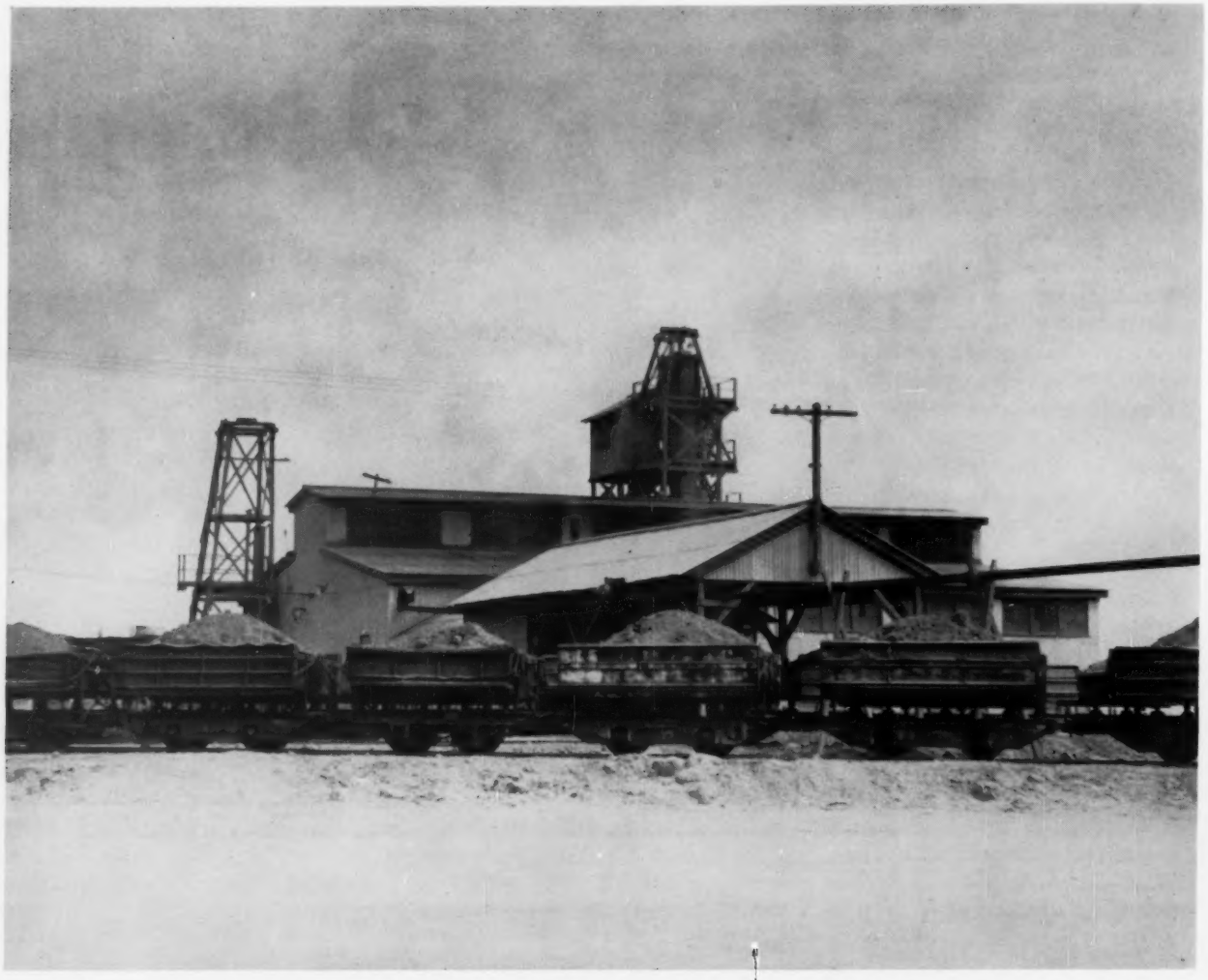
### Drilling and Blasting

The carefully planned methods of drilling and blasting are interesting. Holes for blasting are drilled with three company-designed drills mounted on iron wheels. They are light enough to be wheeled about in the pit by the workmen who operate them. Each drill is powered by a 9-hp. Wisconsin gasoline engine. Jeffrey 1⅞-in. auger bits are used. A fishtail on each bit expands it so that it drills a 2¼-in. hole.

When a drill is placed at a hole location, two operators apply the pressure to hold it and force the auger downward. Holes are drilled a few inches below the salt into the next layer of clay. The holes, 5 ft. apart, are on a straight-in-line pattern all across the narrow way of the pit. From two to six rows of holes are loaded and fired at one time, but the maximum number is never more than 60 holes. Each row has from 11 to 14 holes, with the number of holes depending on the width of the pit.

**MAKING UP PRIMERS: The blasting foreman and helper assemble cap-and-fuse detonators by cutting 6-ft. lengths of safety fuse and inserting the fuse into aluminum shells of No. 6 blasting caps. When used in wet holes, the fuse is waterproofed.**

**AFTER A BLAST: From two to six rows of holes are blasted simultaneously with charges of extra dynamite 30%. A carefully planned blasting method produces a heaving action that results in effective fragmentation of the salt formation.**



**THE PLANT: Loaded mine cars have arrived at the plant where the salt will be crushed and washed. After processing, most of the salt is loaded onto Sante Fe Railroad freight cars for delivery to the trade.**

After a hole is drilled it is loaded with seven to nine cartridges of extra dynamite 30% packed in 1½ by 8-in. cartridges. The number loaded depends upon the thickness and hardness of the rock salt. The loading ratio is 1 lb. of dynamite to 1⅓ tons of rock salt in place. The dynamite charge in each hole is primed with a No. 6 aluminum-shell blasting cap crimped to a 6-ft. length of Sequoia Black safety fuse. The primed cartridges are not placed in the holes until all holes have been loaded. When a blast hole contains water, the fuse is dipped in Celakap, a waterproofing compound.

When the holes have been loaded, each of the two workmen notches a length of safety fuse at fixed intervals so that the fuse spits at the right time to fire the fuse in each hole. The igniting of the fuse in the holes in this way provides an effective delay-detonation effect in each hole. This produces a heaving action that results in effective fragmentation. There's very little fly rock. The hand-lighting with spitting fuse, being accurately timed, is the most effective method that has been found for blasting this salt formation. No secondary blasting is necessary.

After a blast has been fired in a pit, a rail line is built alongside the area, usually between two pits the long way, so that the haulage serves two pits.

### At the Plant

The draglines crawl in, excavate the material, and load it into Western side-dump mine cars of 6 to 8-cu. yd. capacity. From 18 to 22 cars make up a train, which is powered by a Plymouth locomotive with a Caterpillar D-13000 diesel engine. The haul to the plant is about 4 miles. The plant was located this distance from the main salt beds because of the availability of the Santa Fe Railroad at the plant site.

The side-dump cars spill over a 16-in. grizzly into a Jeffrey double-roll crusher, which reduces the material to a minus 3 in. A jackhammer is kept at the grizzly to reduce any oversize lumps. Air is supplied by two Ingersoll-Rand 9 by 9 stationary compressors, which also operate the pumps in 10 wells supplying water for the plant. Other than the crushing operation, the processing is simply a matter of washing the salt.

After the first crushing, the material goes through primary washers, then into a secondary crusher which reduces the salt to ¾ in. and less. From there it moves into a secondary washer. The first and second washers are double 18-in. screw conveyors; the third and last washer is a single 18-in. screw conveyor.

The end product is 98 per cent salt with 1 to 1½ per cent moisture. The salt is an open-textured mass of interlocking crystals of halite. Much of it is clear material.

Most of the salt is loaded directly onto freight cars of the Santa Fe Railroad. Located on the elevator tower are two 50-ton bins, which are used mainly for short-time storage and for truck loadings.

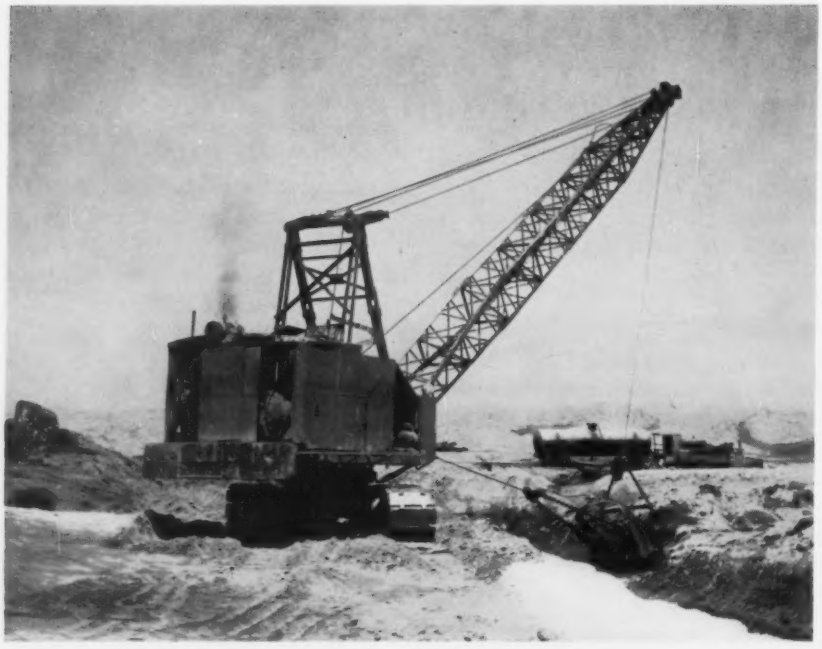
The blasting, excavating, and processing of the salt are more or less a sideline and a necessary thing. But, the big idea is to get at the prime product of the operation, calcium chloride. In times past, the company made table salt; now it turns out only an industrial product. Production is around 700 tons a day.

### Bilelike Brine Seeps Into Trenched Pits

With the salt removed from the pit, leaving a somewhat murky clay bed exposed, the second part of the dual mining operation begins. When the draglines remove and load the salt they also trench the bottom of the pit, cutting down into the underlying clay. Then the natural seepage starts. Bilelike brine, highly impregnated with calcium chloride, oozes out and stands in the trench like stagnant water. As a rule, only every other pit is trenched because fractures in the clay at such intervals are reckoned to be sufficient to seep out the calcium chloride. This follows the same general principle of oil-well spacing.

How the calcium chloride was formed and stored in this desert basin is another mystery of the region. The main thing is — it is there in great quantities. California Salt Company drilled more than 50 exploratory wells in the area of the salt deposits and found calcium chloride at varying depths. However, no rich brine was encountered below 32 ft. So, it is known that there are commercial

**AT THE CRUSHER: The contents of the side-dump cars are spilled over a 16-in. grizzly into a Jeffrey double-roll crusher, which reduces the material to minus 3 in. After crushing, the salt passes through three washers.**



TRENCHING A PIT BOTTOM: Removal of the salt leaves a murky clay bed in the pits. Draglines trench the pit bottoms, cutting down into the underlying clay. As a rule, only every other pit is trenched. This follows the principle of oil-well spacing.

quantities far below the present workings. But, it would be more expensive to recover and there is no need to worry about that at this time, for there is plenty of the product at the present working depth.

California Salt Company has recovered some calcium chloride from wells, but most of it comes from the trenched pits. As the trenches fill, the brine is pumped into tank trucks with 3-in. portable pumps. The four trucks, which are powered with Hercules RXC motors, have a tank capacity of 4,000 gal. each.

### Evaporation Ponds

The liquid is hauled to evaporation ponds, which are earthen pits. Then, old man sun does the rest, drawing off the water into the thin desert air.

The rate of evaporation varies with the weather and, of course, is higher in summer. The average desert rate of evaporation of fresh water is ½ to

CALCIUM CHLORIDE SOLUTION: Natural seepage causes a bilelike brine, highly impregnated with calcium chloride, to ooze into the trenched pits. Solar evaporation removes much of the water and the salt drops to the bottom.

**RECOVERING CALCIUM CHLORIDE: As the trenches fill, 3-in. portable pumps are used to pump the brine into tank trucks. Each tank truck has a capacity of 4,000 gal.**

¾ in. a day. The brine evaporates somewhat more slowly than fresh water.

A constant check is kept on the content of the ponds and when the liquor hits 40 Baumé test – or about 38 per cent calcium chloride – it is pumped into trucks and hauled to storage ponds, of which there are from three to six in use all the time. It is kept in the storage ponds until needed for market demand or until additional evaporation brings it to 38 per cent calcium chloride. It is then hauled to railway tank cars for shipment, or to Hill Brothers Chemical Company which has a flaking plant on the California Salt Company's property. The flaking process is a matter of additional dehydration (in furnaces) of the product. If the liquor is down to the right percentage when it is pumped from the evaporation ponds, it may be hauled directly to the tank cars. The storage ponds vary in capacity from 1,500 to 5,000 tons, the measure by which calcium chloride is sold.

Some of the evaporation ponds have been in use for at least 20 years. In the process of evaporation, the sodium chloride, or salt, drops out and collects at the bottom. After a pond has had three to four fillings, it is given a good scraping to remove the salt. Only recently, a system has been developed whereby water is pumped into the salt-encrusted ponds; the salt goes into solution, is pumped out, and placed in evaporation ponds. In this way, the residue calcium chloride is recovered. Tailings from the salt-washing plant are piped to a ditch that empties into evaporation ponds; in this way the calcium chloride contained in the salt muck and washed out in the plant is recovered.

Calcium chloride has many uses. It is converted into a stabilizer which competes with gelatin. It is used in the manufacture of cement to take out impurities, and in the mixing of cement to prevent drying out. It is also useful in the manufacture of detergents for lubricating oil. California Salt Company finds a ready market for its output. Production just about equals sales, and the company maintains no storage facilities for calcium chloride except in the final ponds in the evaporation process.

W. F. BIEDEBACH: Mr. Biedebach is the president of California Salt Company with headquarters in Los Angeles.

KENNETH STAPLES: Mr. Staples is superintendent of the company's mine and plant near Amboy, California.

### Company History

California Salt Company's history goes back to 1908, when mining men were first conducting tests in the desert to find what it might be hiding. The first operation for the recovery of calcium chloride was planned in 1908, and production was started two years later. From then until 1918, the salt was discarded.

In 1921, many of the claims in the area were acquired by California Rock Salt Company, which produced for Consumers Salt Company. California Rock Salt became California Salt Company in 1923. At that time, W. F. Biedebach, president of the company, joined the enterprise. He has headed up the company for many years and has been a driving force behind the operations. His office is in the company's headquarters in Los Angeles. His son, W. F. Biedebach, Jr., is an associate. Kenneth Staples is superintendent of the company's mine and plant near Amboy.

To a great extent, the pit area, the plant, and the camp are really isolated, being several miles from Amboy and still farther from Twenty-nine Palms, the nearest good-sized shopping center. There is no telephone at the plant or camp. When President Biedebach has to communicate with Superintendent Staples he either sends a telegram or drives down from Los Angeles. Saltus, the railway loading station, is one of the smallest dots on the big map of California.

The plant and camp have electricity which the company makes with a 75-kw. generator, powered by a Caterpillar D-13000 diesel engine. The washing plant is powered with two Fairbanks-Morse diesel engines, one of 180 hp. and the other of 120 hp.

For utility work, the operation uses a Bay City dragline with a ½-cu. yd. bucket. A Galion 201 grader is used to maintain the car- and truck-roads about the plant, in the pit, and in the pond area.

The mining area is on a one-shift schedule. The washing plant is shut down at night and, at that time, necessary repairs are made.

Frank Duke, the mine foreman, oversees the drilling and blasting details. Charles Baxter is the mill foreman, and Pete Mancha is in charge of loading and sacking.

From 45 to 50 men work at the operation. The turnover in personnel has been negligible. Apparently, the people like the desert country that stretches away in every direction toward the blue mountains.

Superintendent Staples is a happy man as he drives between the pit area and the plant. Most of his life has been spent on the desert. "There's no place in the world like it," he said.

# Deep-Hole Blasting In Virginia Granite

**The detonation of 62,800 pounds of dynamite in a high, irregular quarry face produced 144,000 tons of broken rock and a low muck pile**

JOHN DANTZLER*

BUGGS ISLAND QUARRY near Clarksville, Mecklenburg County, Virginia, was opened in the mid-1940's to supply stone for a highway and a Government-sponsored railroad being built in the vicinity. Since that time it has been operated intermittently to furnish high-quality crushed stone for many important projects in south-central Virginia. One of these required the delivery of 4,500,000 tons of various sizes of crushed stone to contractors building the John H. Kerr Dam at Buggs Island. This dam, 2,785 ft. long and 144 ft. high, is part of the Federal Government's combined flood-control and hydroelectric program in the Roanoke River Valley.

Since 1954, Buggs Island Quarry has

*Hercules Powder Company
Pittsburgh, Pennsylvania

**BIG BLAST IN ACTION: The photographer, standing at the side of the blast area in Buggs Island Quarry, took this action picture as 62,800 lb. of Hercules Gelatin Extra 75% and 60% were detonated. The charges were primed with Primacord. Two electric blasting caps, connected to the Primacord at the center holes, initiated the blast, which was fired by a Titan blaster.**

been operated by Marks-Wicker Company, Inc., of Clarksville, Virginia. The face of the quarry, shaped like a large U, has an average height of 120 ft. and is approximately 800 ft. long on each side of the U. The formation, a massive granite, is practically without natural bedding planes and fissures. Its composition includes 30 per cent quartz, 24.2 per cent microcline, 39.4 per cent plagioclase, and 6.4 per cent mica. The formation is difficult to drill. Its abrasiveness causes excessive wear on drill bits and necessitates frequent bit changes.

Until comparatively recently, the details of drilling and blasting in the quarry were carried on in 75 by 250-ft. benches 24 ft. high. Wagon drills were used to put down 2¼-in.-diameter holes on a staggered 5½ by 6-ft. pattern. After some experimenting, officials of the Marks-Wicker Company decided to change to the use of well drills and 6-in.-diameter holes for blasting. Making larger primary blasts would provide sufficient broken stone for several months' uninterrupted plant operations. The new method of drilling and blasting lowered costs and eliminated the difficulty of maintaining uniform grades at the quarry floor level.

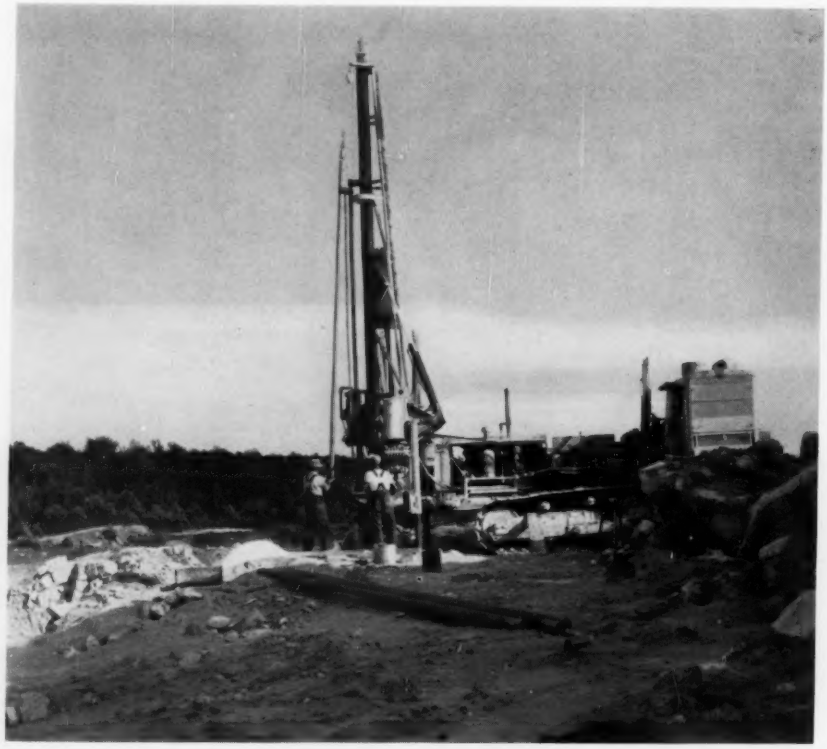
### Well-Drill Blast

Typical of the present technique of deep-hole blasting is a recent primary blast at Buggs Island Quarry when 62,800 lb. of Hercules® Gelatin Extra Dynamite 60% and 75% produced approximately 144,000 tons of rock.

After two power shovels had stripped 20 ft. of overburden from the top of the ledge, the height of the quarry face ranged from 101 to 122 ft. A total of 40 blast holes, 6 in. in diameter, spaced on an average of 18-ft. centers, was loaded with the main charge. The spacings between holes were irregular, from 16 to 23 ft., because of varying conditions in the face. The toughness of the rock made it necessary to drill a row of 2¾-in.-diameter holes 12 ft. deep halfway back from the rim of the face and between the line of the 6-in. well-drill holes. Additional small holes, also 2¾ in. by 12 ft., were drilled between and on the same line as the 6-in. holes.

As indicated previously, the spacings

**TOUGH, MASSIVE GRANITE: The working face in the Buggs Island Quarry, shaped like a large U, is a tough, massive granite formation, practically without natural bedding planes and fissures. Approximately 800 ft. long, it ranges in height from 101 to 122 ft.**



**DRILLING BLAST HOLES: Blast holes, 6 in. in diameter, are drilled with an Ingersoll-Rand Drillmaster. Frequent bit changes are necessary because of the rock's extreme abrasiveness.**

**LOADING EXPLOSIVES:** The blasting crew is at work loading the blast holes with charges of Hercules explosives packed in polyethylene cartridges. All charges were primed with Primacord.

**EXCELLENT RESULTS:** Results of the blast showed excellent fragmentation with the rock moved out from the face in a low muck pile, assuring speedy, economical shovel operations.

between the well-drill holes were not uniform because of the variable contour of the face. As an example, the hole at one end of the group had a 36-ft. burden in front of it, while the three holes next to that end had only 16 ft. of burden. Water, in varying depths, was encountered in nearly all the holes.

### Equipment

The drilling equipment in use at Buggs Island Quarry consists of an Ingersoll-Rand Drillmaster rotary unit for the 6-in. holes, and Gardner-Denver Air Tracs for drilling the 2¾-in. holes. The Drillmaster uses a 3-in. stem, in 20-ft. lengths, and a 6-in. drill bit. The bit, because of extreme wear caused by the abrasiveness of the tough granite rock, must be replaced every 8 to 10 ft. of hole. The Gardner-Denver Air Tracs use a 2¾-in. bit on 1¼-in. drill steel of different lengths. The bits on the Air Tracs must also be replaced with the same frequency as those on the Drillmaster. Air requirements of the Drillmaster rotary were supplied by an Ingersoll-Rand 600-c.f.m. compressor. The entire unit, both drill and compressor, was mounted on a D8 Caterpillar for ease of movement along the top of the quarry face. A Gardner-Denver 600-c.f.m. compressor supplied the demands of the Air Tracs for drilling the smaller holes.

### Loading Well-Drill Holes

The 6-in. blast holes were loaded with Hercules Gelatin Extra 75% and 60% packed in 5-in. by 25-lb. polyethylene cartridges. This type of container is especially valuable when it is desired to increase the loading density of the charges at the bottom of the holes because of the toughness of the rock. In a normal 6-in. well-drill hole 100 lb. of gelatin extra packed in 5-in. by 25-lb. polyethylene bags will compress to 6 ft. Packed in conventional cartridges, it will compress to the usual 8 ft. Another advantage is that a polyethylene cartridge does not "hang-up" when it strikes slight obstructions or irregularities while being lowered in a drill hole.

The explosives charge for each hole was designed to meet specific conditions. However, the overall loading

**THE PLANT: At the plant a Pioneer jaw crusher and a Telsmith 16 B gyratory secondary crusher produce the varied sizes of crushed stone and riprap needed.**

plan did not vary much from hole to hole. Hole No. 2 might be considered typical of the entire group. It was 130 ft. deep with a 20-ft. burden, and spaced 21 ft. from each of the adjoining 6-in. holes. At that point, the height of the face was 122 ft. Calculations showed that an estimated 1,900 cu. yd. of solid rock had to be blasted. Six hundred pounds of Hercules Gelatin Extra 75% were loaded and compacted in the bottom of the hole. The first polyethylene bag was primed with Primacord.* Directly on top of the 75% gelatin extra, 1,050 lb. of Hercules Gelatin Extra 60% were loaded until the column of dynamite reached the 19-ft. mark. At that point, 3 ft. of stemming were placed in the hole and tamped. A charge of 37½ lb. of gelatin extra 60% was then loaded in the hole after which 12 ft. of drill cuttings were added for the final stemming. The total charge of explosives in this hole was 1,687½ lb. The hole contained approximately 6 ft. of water.

*Reg. U.S. Pat. Off. by The Ensign-Bickford Company

†Hercules Trademark

### Loading Air Trac Holes

The Air Trac holes, 12 ft. deep and 2¾ in. in diameter, were loaded with approximately 12½ lb. of Hercules Gelatin Extra 60% packed in the conventional-type 2 by 12-in. cartridges. This charge occupied 6 ft. of the hole. The remaining 6 ft. of hole was stemmed with drill cuttings.

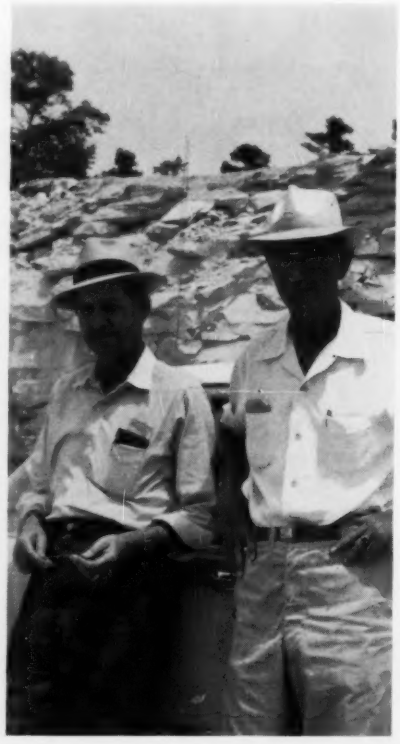
All of the explosives charges were primed with Primacord, the well-drill holes with two strands and the Air Trac holes with one strand. A 17 M. S. connector was tied into the Primacord line between each large hole and between the small holes on the outside row. Two Hercules® Electric Blasting Caps initiated the Primacord at the center of the blast so that the rock movement would be toward the center from both ends. A Titan† blaster was used to fire the blast.

### Excellent Results

The results came up to expectations in every detail: the rock was well broken and moved out from the face; a low muck pile was realized, assuring ease of loading; and there was a minimum of backbreak. Very little secondary blasting will be required. Estimates indicated that the 62,800 lb. of explosives produced 144,000 tons of broken rock. This represents an explosives factor of 2.30 tons of rock per pound of explosives used.

Recovery of the stone will be accomplished with a Model 6 Northwest 1½-cu. yd. shovel and a Lorain 50I 1-cu. yd. shovel. Three 15-ton Euclids and a 15-ton International Pay Hauler will transport the broken rock to the crushing plant. At the plant a Pioneer jaw-type crusher and a Telsmith 16 B gyratory secondary crusher can produce the varied sizes of commercial stone and riprap needed.

The officers of Marks-Wicker Company, Inc., are W. T. Marks, president; A. W. Talbott, vice president; and L. Holt, office manager. At the quarry, J. W. Ligon is superintendent; S. C. Hite is foreman; and James Spragins is in charge of the drilling and blasting operations.



**HOPES REALIZED: A. W. Talbott, left, vice president of Marks-Wicker Company, and J. W. Ligon, quarry superintendent, register smiles as they discuss the results from the blast.**

# Tuttle Creek Dam

## Completion of a $90-million structure across the Big Blue River in Kansas will provide an important key in the control of floods and drought in a 500,000-acre area of the lower Missouri Valley

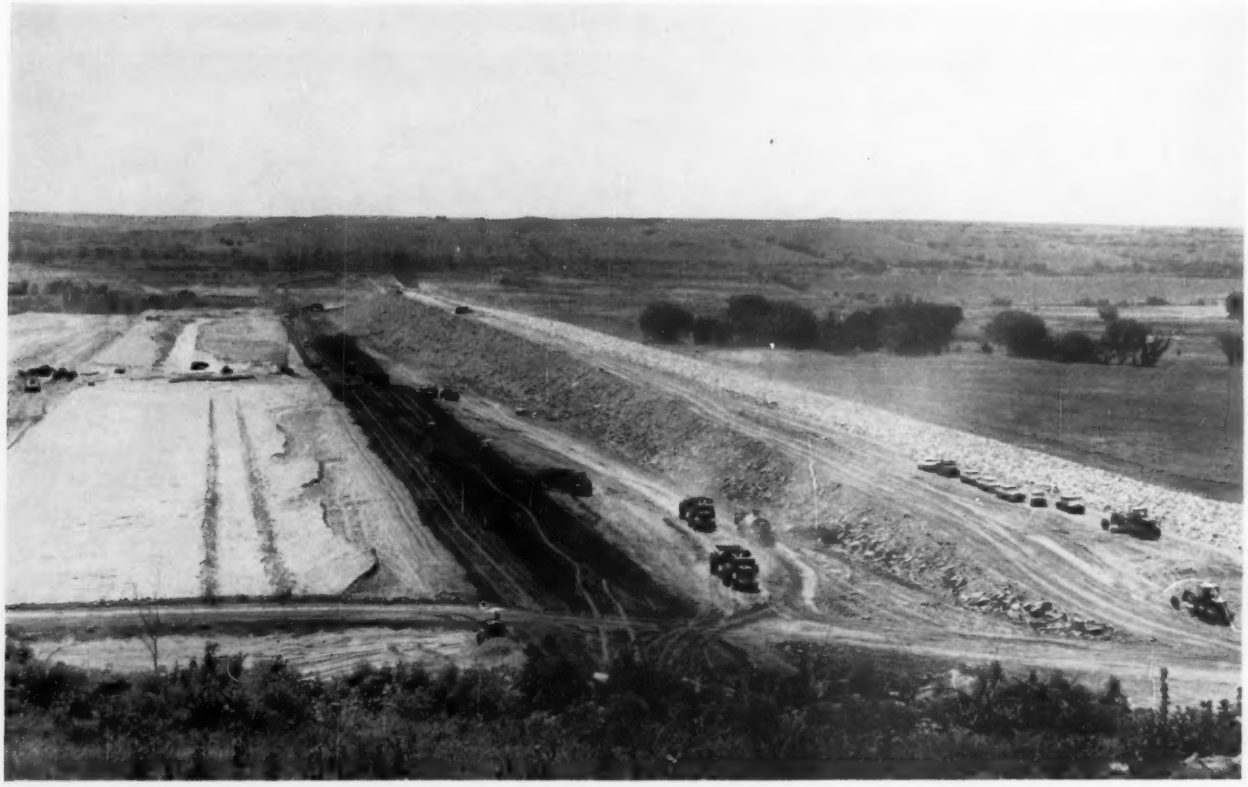
L. H. HOUCK*

TUTTLE CREEK DAM, now under construction across the Big Blue River, 12 miles above its junction with the Kansas River and 6 miles north of Manhattan, Kansas, is one of the important keys to the control of floods in Kansas, and a vital link in the Pick-Sloan plan for drought and flood control in a 12-state area. It is destined to return an estimated $1.50 for each $1 of its cost through the prevention of downstream flood damage, according to reports from the Corps of Engineers, U. S. Army.

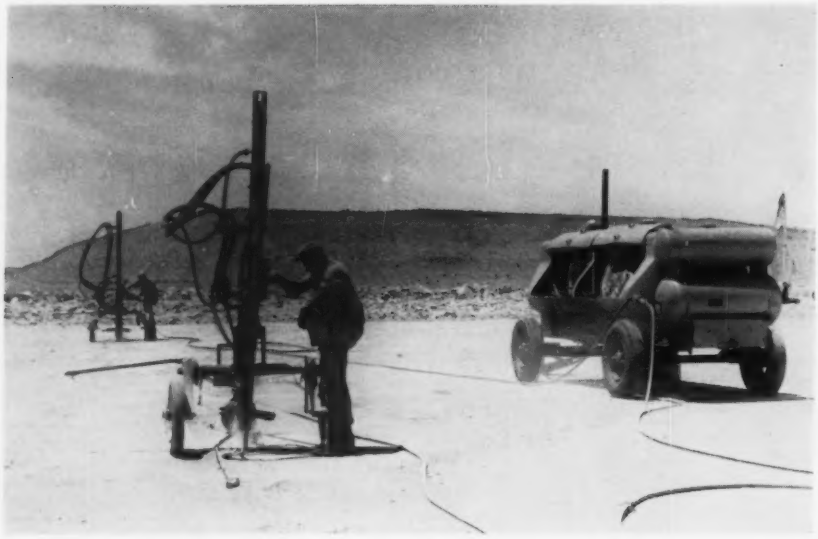
*400 Linden Drive
Jefferson City, Missouri

Tuttle Creek Dam will cost an estimated $90 million, of which about one-half will be spent in construction. The remainder covers real estate, relocations, and engineering. Three small towns, a railroad, and a highway will be relocated.

Tuttle Creek's influence will extend to river communities and farm land in a 500,000-acre area of the lower Missouri Valley, according to the surveys



**TUTTLE CREEK EMBANKMENT: The Tuttle Creek Dam embankment, 7,500 ft. long and 1,640 ft. wide at the base, will contain about 20,000,000 cu. yd. of rock and earth. Its crest will be 157 ft. above the bed of the Big Blue River, and 50 ft. wide. The total flood capacity of the dam will be 2,280,000 acre-feet.**



**COTTONWOOD LIMESTONE: In the 7-ft. layer of Cottonwood limestone, the most durable rock on the project, two Joy TM-350 wagon drills were used to drill blast holes 6 ft. deep on 5 by 7-ft. centers. Preventing overbreak at an underlying seam posed problems.**

completed by the Corps of Engineers. It is the largest of a system of reservoirs of direct value in protecting 5,000 acres along lower Big Blue River and the cities of Manhattan, Topeka, Lawrence, and Kansas City.

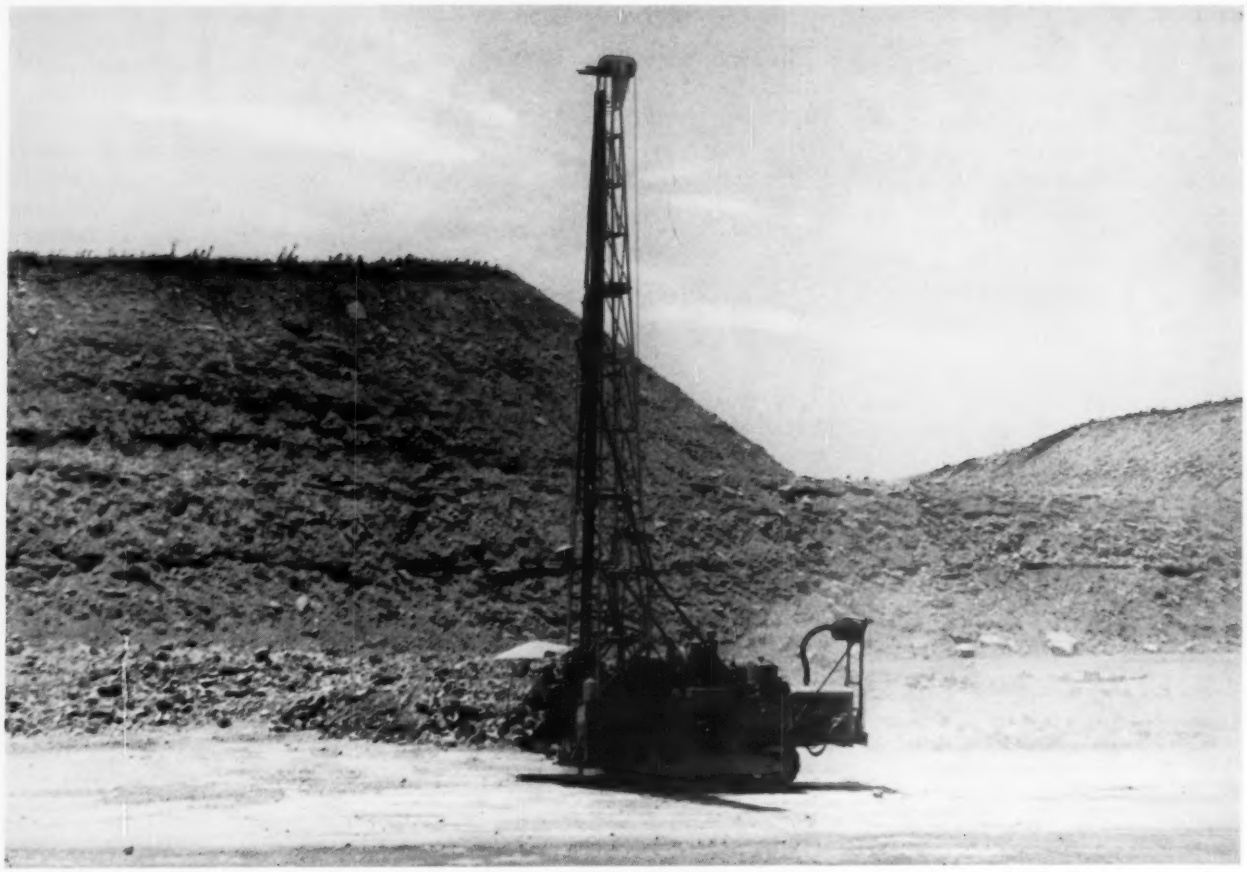
The water runoff from the Blue River Valley in northeast Kansas and southeast Nebraska has established a bad record for dealing death and destruction by repeated floods from Manhattan to Kansas City. These recurring disasters prompted an urgent need for something to be done, and led the Corps of Engineers to develop a basin-wide flood-control plan which has had periodic attention from the Congress.

The Big Blue River basin is 150 miles long and 130 miles wide — an area of 19,500 square miles. Big Blue rises in Hamilton County, Nebraska, and flows 220 miles south through rolling farm land to enter the Kansas River near Manhattan. It is joined by its main tributary, the Little Blue River, at Blue Rapids, Kansas. Although this area is only one-sixth of the Kansas basin, it accounts for one-fourth of the mean annual discharge of the Kansas River.

The construction of Tuttle Creek Dam, named for a small stream that flows into Big Blue a short distance above the dam site, was first recommended by the Army's Corps of Engineers in 1937. Construction was authorized by the Congress in the 1938 Flood Control Act.

Tuttle Creek was included as an element of the basin plans by Congressional Acts in 1941, 1944, 1954, and 1955. Following a billion-dollar flood

**AFTER A BLAST: Primary blasts in the Cottonwood formation yielded excellent tonnage, and the desired break at the 7-ft. seam was realized. Fragmentation was kept within the limits of the specifications.**



**UNIQUE DRILL: For drilling blast holes in the Eskridge shale List & Clark assembled a fast-drilling one-man-operated rig made up of a Joy No. 225 rotary drill mounted on D8 Caterpillar tracks.**

disaster on the Kaw River in the Kansas City area, the first construction work was started in 1952, with an initial appropriation of $5,000,000. Work was interrupted in 1953 and 1954 through lack of appropriations, but it was resumed in 1955. The cost is borne entirely by the Federal Government.

The overall flood- and drought-control plan includes construction of seven large tributary reservoirs. Of these, Harlan County and Kanopolis Reservoirs are in operation, and Tuttle Creek is in the third stage of construction. According to plans of the Corps of Engineers, Tuttle Creek will be closed in 1959 and the project completed in 1961.

### Project Specifications

The dam embankment, 7,500 ft. long, which will tame Big Blue River and act as a throttle on the cantankerous Kansas, will contain about 20,000,000 cu. yd. of earth and rock.

**LOADING BLAST HOLES: After the 4½-in.-diameter blast holes were loaded with charges of nitro carbo nitrate primed with 3 by 16-in. cartridges of Hercules Extra Dynamite 60%, using an explosives loading ratio of 0.51 lb. to 1 cu. yd. of rock in place, they were stemmed to the collars of the holes with drill cuttings.**

The crest of the embankment is 157 ft. above the stream bed, and the base is 1,640 ft. wide at the widest point. The crest will carry relocated Kansas Highway 13 across the valley. The width of the crest is 50 ft. The dam will have a total flood capacity of 2,280,000 acre-feet.

Under the original legislation, Tuttle Creek was to be operated as a dry dam to control floods. As such, it would remain empty until upstream or downstream flood conditions required closing of the outlet works. However, according to the Kansas City District Office of the Corps of Engineers, U. S. Army, the Congress has now approved water storage in the reservoir, but no details on the size of the water pool that can be maintained under the new authorization have been released.

The outlet works consist of an approach channel, control tower, access bridge to connect operating house to the top of embankment, horseshoe

conduits, stilling basin, and outlet channel. Construction of these units is being done under contract to Tecon Construction Company, Dallas, Texas.

As indicated previously, the first work on Tuttle Dam was done in 1952 by George Bennett Construction Company of Bethel, Kansas, which was awarded a contract for $2,238,888 for primary excavation on the spillway and outlet works, making a test fill, and building a construction bridge over Big Blue River.

Other smaller jobs since completed include a steel administration building and a security fence. The initial $5,000,000 appropriation was exhausted in January, 1954.

In 1955, the Congress appropriated $7,500,000 and $9,000,000 was added in 1956. Two important contracts were awarded by the Corps of Engineers in 1956: one, for Stage II, to Tecon Construction Company for $3,673,154, consisting principally of the outlet works; the other, for Stage III, went to List & Clark Construction Company, Kansas City, Missouri, for $4,238,093. This latter contract involves approximately 9,000,000 cu. yd. of excavation, of which almost half is in rock and shale.

### Spillway Excavation

In a big dam construction project the spillway is an important unit, since it functions as an automatic safety valve to prevent the dam proper from being overtopped by flood waters.

At Tuttle Creek Dam it will consist of a 1,500-ft. approach channel; a concrete structure 840 ft. long and 94 ft. high equipped with 18 massive gates, each 20 by 40 ft. and weighing 25 tons; a 600-ft. concrete-lined chute; and an outlet channel connecting with the spillway and the river so the spillway can discharge its water below the dam.

A variety of limestone and shale formations features the excavation for the spillway. This comprises more than one million cu. yd. of rock and almost two million cu. yd. of shale. These items do not include the spillway's outlet channel.

The dam and the major part of the reservoir are in the physiographic section known as the Osage Plains, a typically "scarped plains," where the rock strata dip gently to the west and have been beveled by an ancient erosion plain sloping at a low angle to the east.

The rock formations in the spillway section are all of the Permian Age and belong to the Council Grove group. But, 100 ft. below this group is a 2,000-ft. section of shales and limestone of the Pennsylvanian Age.

The spillway excavation consists of 3,295,000 cu. yd., of which 1,045,000 cu. yd. are in Middleburg, Eiss, Merrill, Cottonwood, and Neva limestones. Shales total 1,950,000 cu. yd., consisting largely of Hooser, Stearns, and Eskridge. There is an additional 697,000 cu. yd. of excavation in the spillway outlet channel, right bank foundation excavation, and foundation stripping. Total excavation involved in Stage III is 4,150,000 cu. yd. and total fill is 8,234,000 cu. yd.

All excavated bedrock is used in the dam as shale and limestone fill. Berm fill consists of surplus from excavated bedrock and protective stone selected from the Neva and Cottonwood limestones.

### Drilling and Blasting

A 7-ft. layer of Cottonwood limestone that lies below the Hooser, Stearns, and Florena shale, and the Eiss and Merrill limestones in most

**BLAST IN ACTION: The photographer took this picture as one of the smaller blasts was detonated in the Eskridge shale. This hard, blocky formation is one of the most prominent of the many shales encountered on the project.**

**RECOVERING BLASTED SHALE: After blasting the shale, the broken rock was excavated with a 5½-cu. yd. Manitowoc diesel shovel loading into 25-cu. yd. Athey wagons with GMC-powered Euclid tractors.**

places on the site, was selected for use as riprap to protect the face of the dam. Tests had shown it to be the most durable rock present. The overburden in some places consisted of small quantities of several other formations such as Speiser shale, Funston limestone, and several others. Some of this had been removed in the original excavation contract for Stage I.

The overburden material stripped from the top of the Cottonwood was used in the embankment section of the dam, which required 20,000,000 cu. yd. of rock and shale.

The Cottonwood is a fine-grained, massive, medium hard, light gray fossiliferous rock, and the amount of it in the spillway area was estimated at 190,000 cu. yd. at the beginning of the List & Clark contract which is now 55 per cent completed.

Since the stratum of Cottonwood averaged only about 7 ft. in thickness, drilling, loading, and blasting had to be geared to accomplish clean cleavage between the limestone and the underlying Eskridge shale.

Holes for blasting in the Cottonwood limestone were drilled 6 ft. deep and spaced on 5 by 7-ft. centers, using two Joy TM-350 wagon drills. The drills were equipped with Timken rock bits on 1¼-in. round steel. Air for the drills was supplied by a 500-c.f.m. Gardner-Denver compressor. Each hole was loaded with three 1½ by 16-in. cartridges of Hercomite® 3 and stemmed to the collar with drill cuttings. Results showed excellent tonnage produced and the desired break at the seam was realized. Fragmentation was kept within the limits of the specifications, which prohibited rock larger than ¾ cu. yd. for use as riprap.

Detonation was accomplished with conventional No. 6 electric blasting caps, except that 25 to 50 short-period delay caps were used in the outside holes of the round. Each blast was fired with a blasting machine.

The explosives loading ratio was 0.41 lb. of Hercomite 3 to 1 cu. yd. of limestone in place. This explosive factor consistently resulted in a yield of more than 10 cu. yd. of rock for each 4 lb. of dynamite loaded.

Normally, about 120 holes were drilled and loaded for each blast in the Cottonwood. Blasting was done at the end of the day shift. The job works 16 hours per day in two 8-hour shifts.

The rock is loaded out with an 80-D Northwest 2½-cu. yd. shovel, powered with a Murphy diesel, into a fleet of six Model C 16-ton Tournarockers with 6-71 GMC diesels.

The haul to the dump at the dam is 5,000 ft. from the excavation operation in the spillway area. The Tournarockers dump on the run and the rock is placed with a rock rake on a D6 Caterpillar tractor.

The other formations, such as the Eiss and Merrill limestones and

Hooser, Stearns, and Eskridge shales, are loaded out with a 5½-cu. yd. Manitowoc shovel, Model 4500, powered with a 600-hp. Cummins diesel. This huge machine dumps into 25-cu. yd. Athey wagons with GMC-powered Euclid tractors, and 25-cu. yd. Euclids powered with both GMC and Cummins diesels. A mixed fleet of 19 such units do the hauling.

### The Eskridge Shale

The Eskridge shale is one of the most prominent of the many shales encountered on the project. It is a hard, massive, blocky formation, greenish-gray in color, with maroon bands about 24 ft. thick. A foot or more of limestone is at the top and bottom. Shale is used in the berm fill, and a mixture of shale and limestone in the embankment.

A unique and fast-drilling rig was assembled in the contractor's field shop for use in shale. It consists of a Joy No. 225 rotary mounted on a D8 Caterpillar tracks and frame from which the engine had been removed. A GMC 4-71 two-cycle diesel was mounted on the front end and hooked up to power the drill, the hydraulic pump, and as motive power for the tracks. It is operated by one man, who drills a hole, pulls up bit, and moves to the next hole location without leaving the seat. This efficient rig normally drills 2,000 ft. of 4½-in.-diameter holes in two 8-hour shift days. A tungsten carbide insert-type rock bit was used with good success.

A typical round in the Eskridge shale comprised 180 holes drilled on 12 by 15-ft. centers to depths of 25 to 35 ft. In dry weather the holes were loaded with a nitro carbo nitrate blasting agent primed with Hercules® Extra Dynamite 60%. However, in the wet holes, the charges consisted entirely of Hercules Extra 60%.

A hard band in the Eskridge shale at the 12-ft. level, averaging 3 ft. thick, placed the blasting of this material on the borderline of nitro carbo nitrate and conventional high-strength dynamite. During normally dry conditions, the nitro carbo nitrate was used successfully despite the presence of the hard band. When the holes were loaded with nitro carbo nitrate, primer cartridges of Hercules Extra 60% in 3 by 16-in. cartridges were placed at the bottom of each hole and at 6-ft.

DREDGING: A suction dredge built by List & Clark was floated in the borrow pit and pumped sand to the pervious section of the dam. The dredge has a crew of four and is worked 24 hours. Its capacity is in excess of 500 cu. yd. an hour.

intervals. Holes were stemmed to the collars with drill cuttings.

The explosives loading ratio was 0.51 lb. to 1 cu. yd., with about 8,000 lb. of both types of explosives loaded in a typical day.

The average hole contains 80 lb. of nitro carbo nitrate and 25 lb. of Hercules Extra Dynamite 60%. Primacord* was used as the primer in each hole. All holes were connected to two trunk lines of Primacord. Blasts were fired with a blasting machine.

The blasted shale was excavated with a Manitowoc 4500 dragline with an 8-cu. yd. Hendryx bucket. This big machine, powered with twin 6-71 GMC two-cycle diesel engines, loaded into Euclid 25-cu. yd. bottom dumps pulled by Euclid GMC-powered tractors.

### Dredging

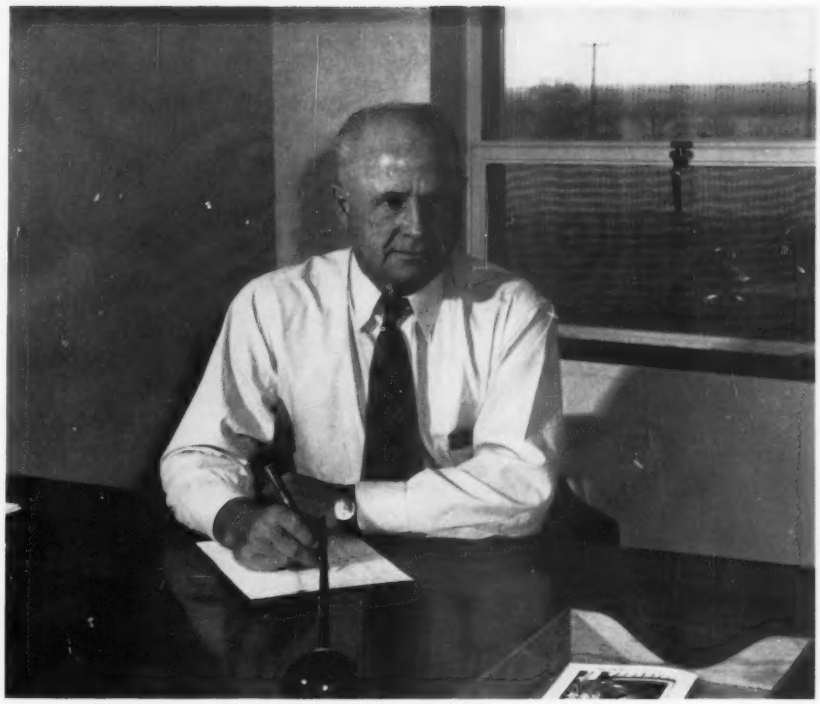
Unique in the Kansas prairie country is a suction dredge built by List & Clark, which excavates sand. It floats in the borrow pit and pumps sand to the pervious section of the dam. The dredge has a crew of four and works 24 hours. Equipped with two 1500-hp. electric motors and one 1250-hp. electric motor, it has a capacity in excess of 500 cu. yd. an hour.

Eight 25-cu. yd. bottom-dump Euclids also hauled excavated material from this area. They were loaded by two 2½-cu. yd. Northwest 95 draglines.

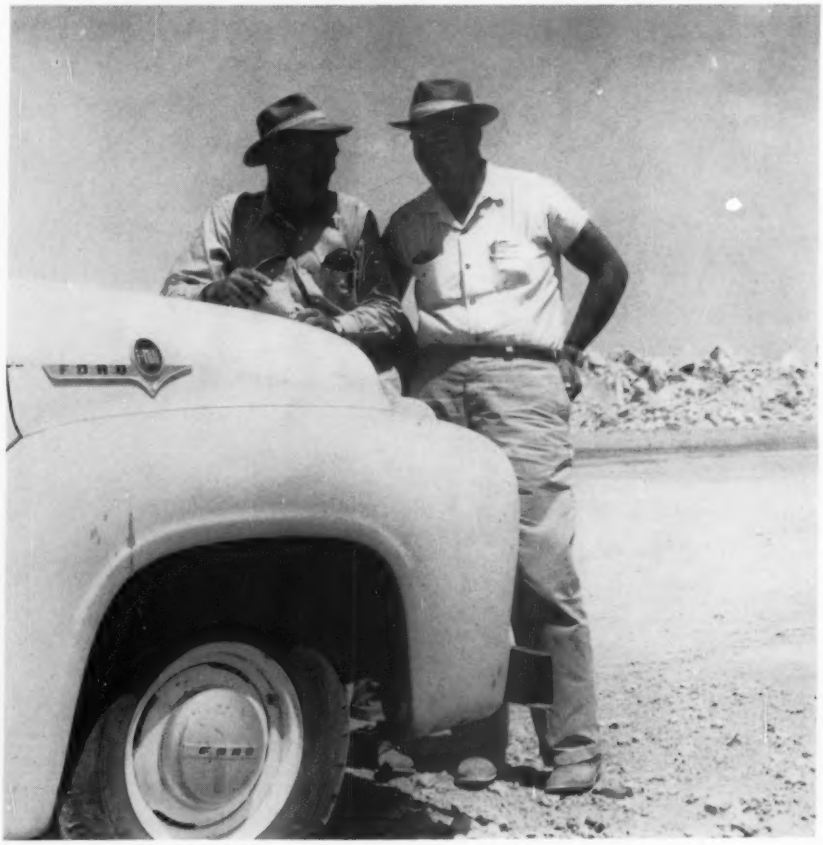
Tuttle Creek Dam is a project of the Kansas City District of the Corps of Engineers, U. S. Army. Colonel E. B. Adams is district engineer. B. V. Reany, project engineer, a veteran of many big dams, has been in charge since the job started. J. H. Dennis is office engineer.

List & Clark Construction Company, Kansas City, Missouri, is well known in the Pick-Sloan flood-control area of 12 states, having had various construction contracts in Nebraska and the Dakotas. Its officers are: C. E. Clark, chairman; C. E. Clark, Jr., president; J. W. Frisbie, vice president; J. M. Clark, vice president; J. E. Irwin, vice president; and D. W. Davis, secretary. Dean Peters is general superintendent for the company and W. T. Buford is assistant superintendent.

*Reg. U. S. Pat. Off.
by The Ensign-Bickford Company



**PROJECT ENGINEER: B. V. Reany is project engineer for the Corps of Engineers, U. S. Army, at Tuttle Creek Dam.**




**CONTRACTOR'S KEY MEN: Dean Peters, left, general superintendent for List & Clark, discusses job progress with W. T. Buford, assistant superintendent.**

# Concrete Coal Tipple Removed With Explosives

## Contractor completed a difficult project quickly and economically without damage to nearby railroad tracks and structures

J. S. ONG*

THE era of the steam locomotive at the Chicago & Northwestern Railroad yards in Madison, Wisconsin, came to an end on August 2, 1957, with the demolition of a 34-year-old coal tipple with industrial explosives.

*Ong Blasting Service
3432 Sunset Drive
Madison 5, Wisconsin

Acme Salvage Company of Madison had the contract for the removal of this reinforced-concrete coaling station that measured 30 by 20 ft. and 85 ft. high. The Acme company subcontracted the job of knocking down the concrete structure to Ong Blasting Service, also of Madison.

OLD COAL TIPPLE: The removal of this old coal tipple with explosives posed problems because of proximity of two railroad tracks and company workshops.

The tower of the tipple had to be made to fall only one way, to the west. The workshops of the railroad company were to the east. To the north and south were two tracks that led to the roundhouse, one track extending under the tower and the other along the east side. The foundation walls and pillars of the tipple were made of concrete 2 ft. thick, heavily reinforced with 1⅛-in. steel bars. On the west side, the walls of the 7 by 8-ft. elevator were 8 in. thick.

A Joy L-37 sinker drill, powered by a Joy 75-c.f.m. air compressor, was used for the drilling. Drill steel lengths were 18 in. up to 6 ft., equipped with Timken 1⅜ to 1⅞-in. detachable rock bits. Holes for blasting were drilled a little more than halfway through the concrete, spaced 18 in. apart. In some cases, 6-ft. vertical holes were used and deck-loaded with charges of ¼ lb. of dynamite every 2 ft., primed with Primacord† and an electric blasting cap. Sand was used for stemming.

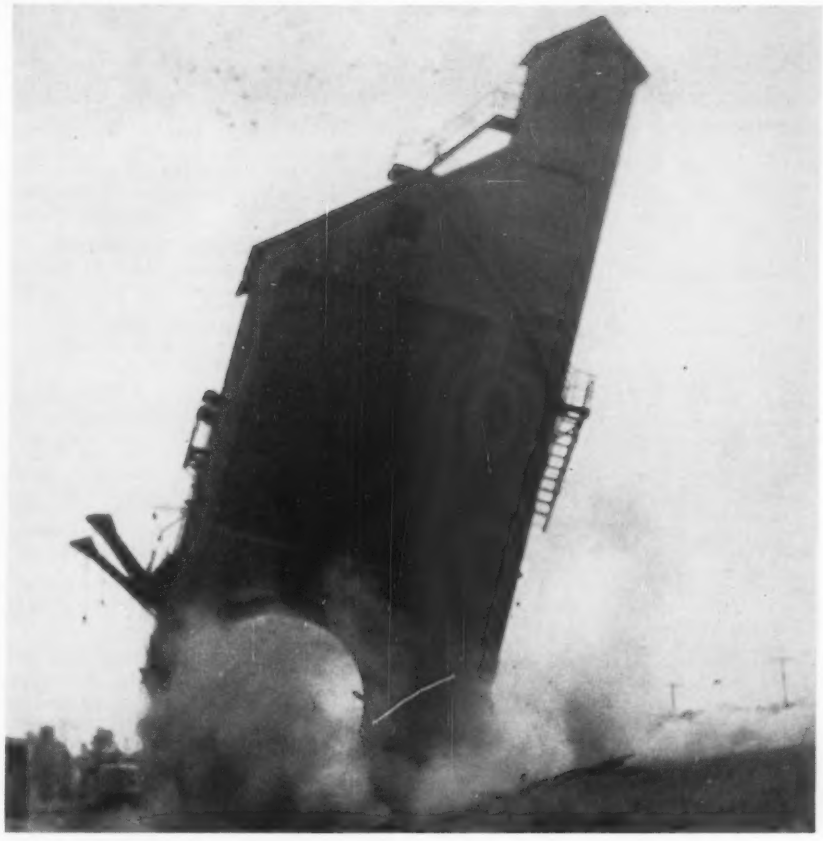
The explosives used were Hercules® Gelatin Extra 30%, in 1 by 8-in. cartridges, and some 40%, 1¼ by 8 in. Fifty pounds of these gelatins were used in 66 holes in the primary blast. The charges were primed with short-period delay electric blasting caps, from zero to seven periods of delay. Each hole in the walls and columns was loaded with one-third of a 1 by 8-in. cartridge of gelatin, and each hole in the foundation with one 1½ by 8-in. cartridge. The charges in the pillars

†Reg. U.S. Pat. Off.
by The Ensign-Bickford Company

were covered with a mat made of old rugs tied in place with rope. This was done to minimize the danger of small bits of concrete flying into nearby buildings 100 ft. away. The 66 short-period delay blasting caps were connected in two series. The blast was fired with a Hercules 50-cap blasting machine.

Some secondary blasting was done to reduce some of the thicker sections of concrete and expedite power shovel loading into dump trucks. For this work 25 lb. of gelatin and 83 delay blasting caps were required. No damage to surrounding tracks and structures was reported.

The cost of drilling and blasting involved in knocking down the old coal tipple was $300 for primary blasts and $110 for secondary blasting – a total of $410. The demolition operations were completed in a little over three days.



**SKILLFUL BLASTING: The detonation of 66 charges of Hercules Gelatin Extra 30% and 40% caused the tower of the tipple to fall to the west as planned. The charges were primed with short-period delay electric blasting caps.**

# NEWS NOTES

### SHAFT-TUNNEL EQUIPMENT

A new series of crawler equipment for shaft and tunnel excavation has been announced by Joy Manufacturing Company. Called the JSL-7 Shovel Loader, JMD-7 Mining Dozer, and JMT-7 Mining Tractor, the machines come with either air or electric drive. With separate motors and independent track control for each track, one track can run forward and the other reverse to permit gradual or pivot turns or complete reversals within the machine radius.

Joy claims the shovel loader can load 2 to 4 tons a minute. The loader can muck in round or rectangular shafts and takes over loading in the tunnel when the shaft reaches bottom. Buckets ranging in size from 5 to 11½ cubic feet are available.

In tunnel construction, the JMD-7 Dozer cleans up invert sections before concrete is placed. It is used for cleaning out old, silt-laden water and sewage tunnels.

The tractor serves not only as a base for the shovel loader and dozer, but for various other attachments as well. These make it a full-face drill jumbo, roof bolter, front end loader, back-hoe, scaler, or fork lift; it can do general drawbar work. Drawbar pull is 12,080 pounds.

Complete information can be had from Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.

### MODERN MINE MACHINERY

"Modern Mining," a catalog of modern, heavy-duty machinery in today's mine, has recently been released by Caterpillar Tractor Co.

Showing how the crawlers, wheel tractors, tractor-shovels, and motor graders manufactured by Caterpillar help increase production in many ways, "Modern Mining" explains through actual job reports and "on-the-spot" photos the versatility of these units. From bulldozing and ripping overburden to primary power and hauling, the illustrated color booklet takes the reader through many of the mines which, according to the manufacturer, have profited by using dependable Cat-built machines. The booklet also lists condensed data on some of the more recent units and discusses the benefits of the large Caterpillar dealer oganization throughout the country.

Copies of "Modern Mining" are available from Caterpillar dealers or by requesting Form No. 32554 from the Advertising Division, Caterpillar Tractor Co., Peoria, Illinois.

### UNDERGROUND LOCOMOTIVE

A 1½-ton underground diesel locomotive for mining and tunnel work, with fumes from its engine exhaust removed by a catalytic purifier, is being introduced by the Hack Engineering Company of Denver, Colorado, as part of its line of Universal diesel locomotives.

A hydraulic-driven unit, the new Universal locomotive is simple in construction, easily maintained and generates equal speed and power in both directions. Powered with a Deutz diesel engine of 18 horsepower, it has a drawbar pull rated at 650-670 pounds.

The locomotive is ideally suited for small mine operations and for transporting material from drifts to main hauls, the manufacturer states.

For more complete information, communicate with Hack Engineering Company, Denver, Colorado.

### GAS AND VAPOR DETECTORS

Mine Safety Appliances Company, Pittsburgh, offers a line of portable instruments which, according to the manufacturer, are designed to meet every industrial need for detecting and measuring flammable gases and vapors.

Four models, each intended for specific functions, are included in this line of combustible gas indicators. All models are the same size and use standard detector and compensator filament units which are obtainable from MSA warehouse stocks throughout the country. A spare set of easily replaceable filaments is mounted within each instrument.

The instrument weighs only six pounds, in contrast with the 12-pound weight of earlier models. Power to operate it is supplied by eight dry-cell flashlight batteries.

The line of M-S-A Combustible Gas Indicators is described in Bulletin No. 0804-2. Copies may be obtained without obligation by writing Mine Safety Appliances Company, 201 N. Braddock Avenue, Pittsburgh 8, Pa.

### SCHRAMM ROTARY DRILL

A new, diesel-powered, truck-mounted rotary drill, known as the Rotadrill, has been announced by Schramm, Inc. According to the manufacturer, costs are lowered because fuel consumption is reduced as much as 70 per cent in comparison with units employing a compressor driven by the truck's gasoline engine. Field reports show that this unit makes holes 600 to 700 per cent faster than is possible with the best churn-drilling techniques.

The diesel engine, an International Harvester UD 1091, is direct-coupled to a Schramm air compressor with no connection to the truck engine. Hydraulic pumps, the oil-cooling system, and dust-collecting fan are all driven by the diesel engine. Normally, the compressor delivers 450 cfm at 20 psi. However, for dewatering or breaking out blockages, air pressure can be boosted to 200 psi.

Rotary air drilling is accomplished through a reversible hydraulic motor-driven head, mounted on a carriage that rides tracks mounted on the mast. This hydraulic head plus the guide slips eliminates the need for a rotary table. Holes can be drilled to 700 ft. with 4½-in. OD drill pipe, and to 1,500 ft. with 2⅞-in. OD drill pipe. Maximum down pressure is 25,000 lb. and maximum lifting pressure is 19,000 lb.

Additional information on the Schramm truck-mounted, diesel-powered Rotadrill is available from Schramm, Inc., 900 East Virginia Avenue, West Chester, Pa.


VIBRATION TROUBLES?

EXPLOSIVES USERS — If you are experiencing or anticipate legal or public relations problems arising from blasting effects—

*Send For Our* **BROCHURE** *Describing Our Services*
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# 40-R and 50-R Drills Prove Superior In Taconite and Other Hard Ore Bodies

Bucyrus-Erie rotaries are offering welcome relief to the problem of steadily mounting production costs. Applied in taconite and a variety of other extremely hard formations, they soon increase the rate of penetration so greatly that one Bucyrus-Erie rotary is able to replace several cable tool rigs.

Using compressed air to cool the bit and to clean the hole of cuttings, the 40-R and 50-R offer several advantages. By removing the need for water—a problem during cold weather—they eliminate auxiliary equipment, cut maintenance and labor costs. Heavy cuttings pile up adjacent to the drill, providing handy, excellent stemming material. Dry sampling of the hole can be accomplished easily and more accurately.

These and other features provide the fine performance that promises even greater economies in the future. Two rotaries are available—the 40-R for drilling 6¾- to 9-in. holes, the 50-R for drilling 9⅞- to 12¼-in. holes. Get all the facts on these drills today.

54B57C

BUCYRUS-ERIE COMPANY

**South Milwaukee, Wisconsin**

**AT STEEP ROCK LAKE**— Cost records for this 40-R, working 140 miles west of Port Arthur in Ontario's Rainy River district, show that the machine cut drilling costs per foot of hole by more than 50 per cent. The 40-R drilled 9-in. holes to the same average depth drilled previously by cable tool rigs.

**AT A WESTERN IRON MINE**

— Some of the toughest rock drilled by a 50-R was encountered here. On this assignment the 50-R shown here drilling 9⅞-in. holes, put down over three times as much footage per shift as each of the four cable tool drills it replaced.

**ON THE MESABI RANGE**

— Bucyrus-Erie 50-R rotaries are now drilling blast holes through taconite formations. A 50-R at one mine reduced costs as much as 34 per cent, and achieved a rate of peneration four times as great as the penetration rate of standard cable tool rigs.

**IN LABRADOR**— Drilling both 9-in. and 9⅞-in. holes, this Bucyrus-Erie 50-R was used to put down hole through material consisting of up to 63% iron and 2½% to 12% silica, with overburden made up of non-formation and dolomites. The overall performance of this 50-R was so favorable that the company later ordered five more.

# IMPOSSIBLE WITHOUT EXPLOSIVES

To break down coal seams interspersed with thick bands of heavy rock and slate, a strong, dense grade of permissible powder is needed to get economical results from blasts.

Hercules manufactures such a permissible powder, along with other grades and strengths of explosives to meet the many and varied conditions in coal mines throughout the nation.

Our technical sales-service representatives welcome the opportunity to discuss with you Hercules permissible powders in "King-Size" cartridges, and to show how their use results in improved methods of blasting and more efficient operation of your coal mine.

XR57-3

*HERCULES POWDER COMPANY*
INCORPORATED

*Explosives Department, 990 King St., Wilmington, Del.*

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# G-800 TRACDRIL

## GOES WHERE YOU WANT IT...

And starts drilling! Just one man can move a self-propelled CP Tracdril from hole-to-hole in double-quick time . . . requires no "bull work" . . . tows its own compressor. "Knee-action" tracks compensate for uneven ground. A hydraulically operated U-Arm assures quick positioning for running bench holes or lifters. Hard hitting 4" CP-400 Drill and CP Drill Carriage are combined to afford maximum drilling speed, feed and stability.

Reversible tramming motors enable the Tracdril to whip into reverse, go forward and pivot . . . have "dead man controls" for greater safety.

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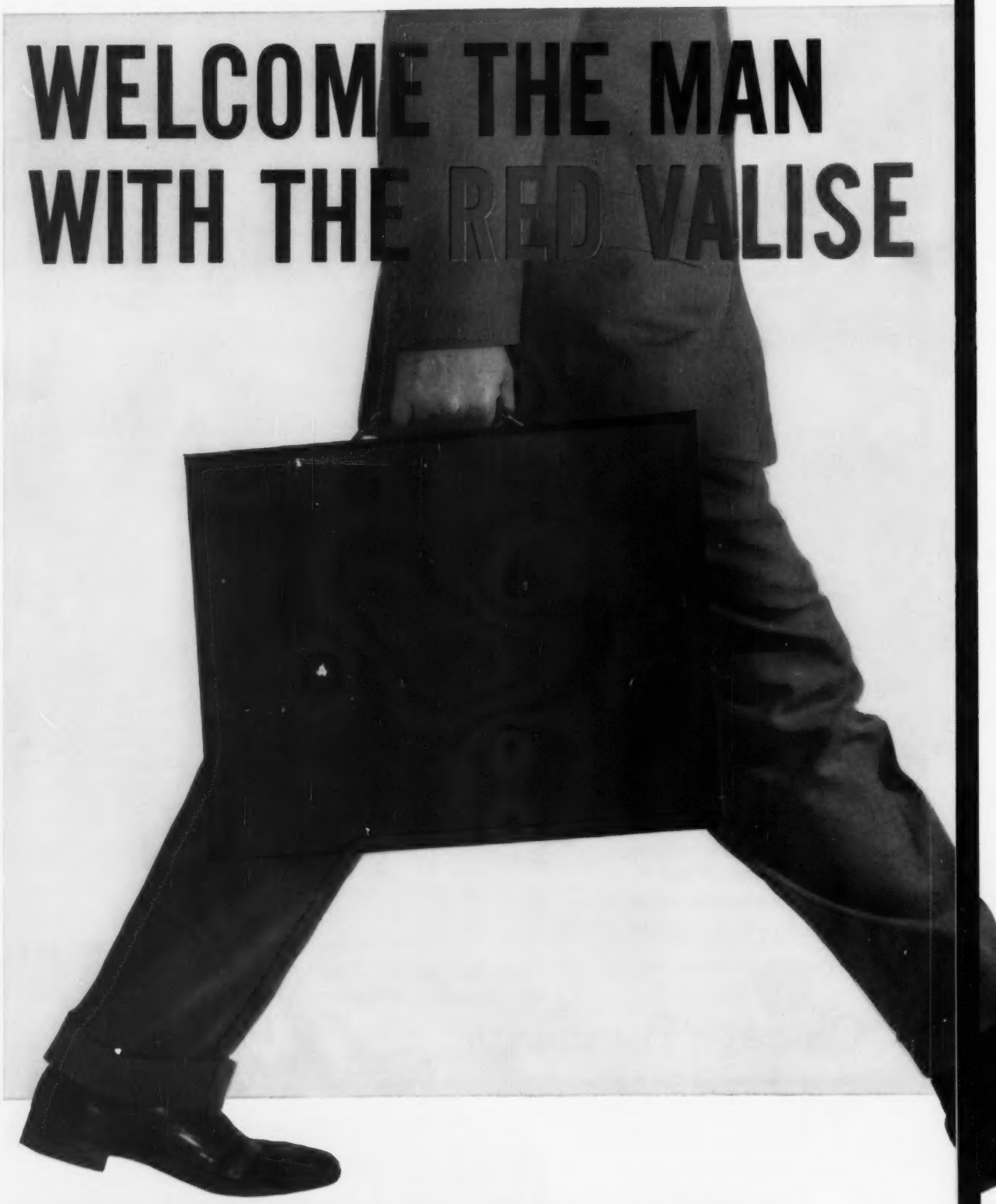
VACUUM PUMPS • AVIATION ACCESSORIES

# WELCOME THE MAN WITH THE RED VALISE



HERCULES **BLASTING CAPS**

*Partners in Dependability with Hercules® Explosives*

# He can show you why Hercules sets the pace in Blasting Caps

Whatever you need in a blasting cap, Hercules has it—And the Hercules representative can show you an actual dummy sample from this "full line" kit. The Man with the Red Valise will be calling on you soon—if he hasn't already—and when he does you'll learn why Hercules is a recognized leader in blasting cap development.

Look at this Hercules lineup:

**Electric Blasting Caps**—Manufactured in two strengths with plastic-coated copper leg wires available in lengths from 4 to 250 feet.

**Waterproof Electric Blasting Caps**—Designed to withstand high water pressure.

**No Vent® Delay Caps**—One-piece, all-metal shell. No Vent helps prevent misfire in wet work. Available in delay periods from "0" to "15". An exclusive Hercules development.

**No Vent® Short-Period Delay**—Similar in construction to No Vent cap but in 27 delay periods from 25 milliseconds to 2950 milliseconds.

**Electric Squibs**—Special firing devices for use with black blasting or pellet powder where electricity is employed.

**Special Packings**—All-electric blasting caps may be obtained packed on cardboard spools for easier handling. Primatube®, a rigid cardboard tube available for some types of caps, makes a primer when the tube is fitted over a dynamite cartridge.

**Seismic Aids**—Vibrocap® SR has been designed especially for seismic prospecting; it registers the "time-break" accurately throughout the entire range of low and high firing currents. Titan® Booster 20, a special booster detonating device for use with regular Hercules® Electric Blasting Cap or Vibrocap® SR, is also available.

You name it and the Man with the Red Valise will show it to you.

**HERCULES CAPS FEATURE:**

**Dependable Fire**—Special alloy is used as the bridge wire in the firing element of Hercules Electric Blasting Caps. Wire is noncorrosive.

**Engineered Shell**—Bronze shell of a Hercules cap goes through fifteen separate operations while it is being expertly shaped.

**Tough, High Dielectric Insulation**—Leg wires of Hercules caps are coated with plastic insulation for outstanding toughness, resistance to abrasion, superior dielectric qualities.

**Double-Packed Wallop**—Bridge wire extends into the priming charge and makes positive contact to give rapid ignition.

**Securely Anchored**—A cast sulfur plug in the upper part of shell anchors entire firing mechanism in place.

**Watertight Waterproofing**—A special Hercules waterproofing formulation minimizes the possibility of moisture or dampness penetration.

*Explosives Department*

***HERCULES POWDER COMPANY***

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XR57-6

## Flexibility plus!

# NEW GARDNER-DENVER DELUXE "AIR TRAC"®

### 210° Swing

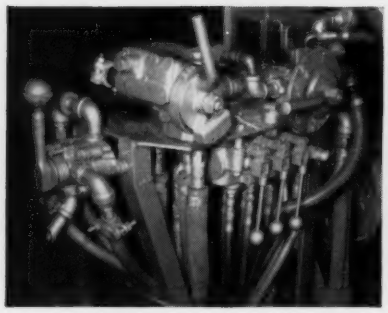
Hydraulic cylinder provides 120° swing, can be indexed for an additional 90° swing.

### 360° Dump

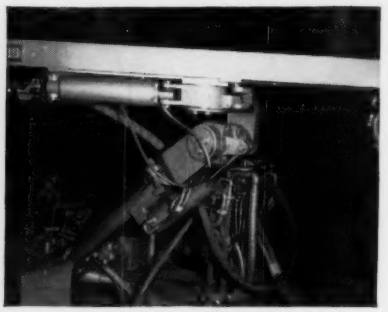
Hydraulic cylinder provides 90° dump, can be indexed a full 360°.

### 86° T-Bar Lift

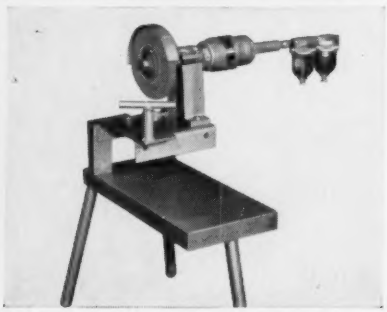
Twin hydraulic cylinders provide T-bar lift of 86° 30′, from below horizontal to nearly vertical.



New Remote Control Panel and Driver's Seat—centralized controls provide instantaneous control of swing, dump, T-bar lift, crawler tracks and all drilling operations. Designed for convenience, comfort and safety. Saves minutes and reduces operator fatigue.



New DPAT Hydraulic Drill Positioner —this creep-free hydraulic system maintains alignment at all drilling angles and avoids stuck steel. Provides fast, effortless, power positioning for all vertical, horizontal and flat lifter hole spotting.



New Model G-2 Bit Grinder—this deluxe "Air Trac" extra saves time, too. No need to send back or wait for bits —you sharpen spare bits on the job. Plus new free-wheeling drive shaft design for towing "Air Trac" . . . tool box for tools, bit and coupling storage.

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